LogIT

Data Logging system

LogIT Lab for Windows
starter software

Instruction manual

LogIT Lab Starter Software

This manual is divided into four sections:
- Installing the software
- Tutorial (how to use the software)
- Classroom investigations
- Technical specifications

Tutorial

This section is written as a tutorial for complete beginners. It is divided into lessons which can be studied individually or worked through in order. The tutorial is also built into the LogIT Lab software and can be read by selecting Tutorial from LogIT Lab's Help Menu.

LogIT Lab software has extensive help built-in. This is accessible from the program's Help menu, from which you can search for help by typing in keywords or by following links. In addition, Help buttons are available at various places in the program and the key F1 will display relevant help at most times

Classroom investigations

These are a range of typical classroom experiments described in a step by step fashion. Each includes an equipment list and most include a typical results graph and ideas for discussion and further investigation.

LogIT Lab software includes a database of equipment designed to help you choose appropriate equipment for the investigations you wish to carry out. Select Choosing Equipment from the Help menu.

To keep up-to-date with general LogIT developments, such as new sensors, and for LogIT Lab software updates, visit the LogIT Internet site: **www.dcpmicro.com**

Installing the Software

Before the software can be used it must be installed on your computer.

Installation requires about 3Mbyte of free space on your hard disk. The software is distributed in one file (SETUPEX.EXE). Any other files supplied are not essential.

The software requires one of the following systems to be running on your computer:

Windows 3.10	Windows 95	Windows NT 4.0
Windows 3.11	Windows 98	

(or a later compatible version).

Before starting the installation you should exit any programs running on your computer, other than Windows itself. As an added precaution it is advised that you first restart Windows, if it has not just been started.

Experienced PC users

To install the software simply run the supplied file SETUPEX.EXE and follow the on-screen instructions. The installation does not do anything particularly nasty, but for piece of mind there are technical details of the installation process in the file TechInfo.txt.

Inexperienced PC users

To install the software on your computer use one of the following methods. In each case there is a variant of the instructions for older '16-bit' Windows systems (namely Windows 3.10 and 3.11) and for '32-bit' Windows systems (Windows 95, 98 and NT 4.0).

either Double click on the file SETUPEX.EXE from the file manager or explorer

From Windows 3.x with the LogIT Lab floppy disk in drive A

a/ Start the File Manager and open a view of floppy disk A - this should show the file SETUPEX.EXE

b/ Double click (click twice quickly) on the file SETUP.EXE - this should start the installation

From Windows 95, 98 or NT 4 with the LogIT Lab floppy disk in drive A

a/ Double click (click twice quickly) on the My Computer icon, usually at the top left of the screen

b/ On the resulting window, double click on the floppy disk A icon

c/ Double click on SETUPEX.EXE in the window shown - this should start the installation

or Type the command to run the file SETUPEX.EXE

From Windows 3.x with the LogIT Lab floppy disk in drive A

a/ Select Run from the File Manager or Program Manager's File menu

b/ Type A:\SETUPEX.EXE and press the ENTER key - this should start the installation

From Windows 95, 98 or NT 4 with the LogIT Lab floppy disk in drive A

a/ Select Run from the Start menu (usually the Start button is at the bottom left of the screen)

b/ Type A:\SETUPEX.EXE and press the ENTER key - this should start the installation

Once the set up program starts you should follow the instructions given on-screen. You should read the licence and 'readme' information shown. You will be asked for your name and the name of your organisation, where you wish to store the program on your hard disk and where to put the program in your start menu or program manager. In each case a suitable default value is given, so its quite painless.

Running the software

Once installed the program can be run in the usual ways:

Windows 3.10 / 3.11	Double click on the LogIT Lab icon in the Program Manager
Windows 95 / 98 / NT 4	Select LogIT Lab from the Start Menu's Programs list

Removing the software

If you wish to remove the software from your computer you can do so with the Uninstall program provided.

You may not wish to leave the Uninstall option openly available on your computer, in which case you can remove it:

Windows 3.10 / 3.11	Click once on the LogIT Lab Uninstall icon in the Program Manager and press the Delete key.
Windows 95 / 98 / NT 4	Select Start Menu / Settings / Taskbar. Then select the Start Menu Programs tab. Locate the LogIT Lab Uninstall program and select Remove.

The Uninstall program is the quick and clean way to remove the program, but it is safe to just delete the LogIT Lab program folder and associated icons or menu items.

Tutorial - What is data logging?

Data logging is the recording of information over a period of time.

Data logging can be carried out manually, by making observations and then writing them down, or electronically with a data logger.

Manual methods require you to be there to observe and write down the results. This can be inconvenient or even impossible. Also the total duration of any experiment is limited by the speed you can write and by your stamina.

Electronic data loggers can record data far more quickly than a person can write and over a far longer period than a person can stay awake. All LogIT data loggers can record 100 measurements a second and can be left to run for months.

Manual data logging often involves hand drawing a graph, but with electronic data logging the graph can be automatically generated in a fraction of the time. This frees time for more important aspects of the experiment. We are not suggesting that graph drawing skills should be ignored, but they need not monopolise every experiment.

With computers now so common place, experimental data will often be processed by computer and reports will often be created using a computer. So its a natural move to use computers to collect the data in the first place.

At this point its worth establishing some common terminology. The following descriptions are not dictionary definitions, but describe terminology as used within the LogIT system.

A data logger is a box of electronics which can be connected to a computer and into which sensors and other accessories can be plugged.

This software supports a number of different loggers, represented by the following icons:


LogIT SL


LogIT Live


DataMeter 1000

Some loggers are able to collect data independently of the computer, then later the data can be read by the computer for analysis. These are called remote data loggers, of which LogIT SL and DataMeter 1000 are examples.

Other loggers can not store data themselves and thus must be connected to a computer for logging. However, when fitted with a display (such as CheckIT), these devices make useful multi-channel meters. This type of logger should more correctly be called an interface than a data logger. LogIT Live is an example of this type of *logger.*

Loggers need a source of electrical power in order to work. If your logger is battery powered, remember to fit a battery!

In order for a logger to be able to measure anything it requires one or more sensors to be connected. The sensor's job is to convert an external property (like temperature) into an electrical signal the logger can measure.

Within this software sensors are represented by icons, some of which are shown below:


Temperature


Magnetic field


Sound level

This software offers a totally automatic data logging system, called AutoLog, which identifies the sensors, selects suitable graph scales and will log data for as long as you leave it running. This makes most experiments very easy to monitor. Just plug in the sensors and select start.

For more demanding tasks you can select your own logging rate, experiment duration and sensor scales. You can even select Snapshot logging, where readings are only stored on your request. This is used for experiments which are not time dependent.

In addition, you can choose to time events, such as the time an object takes to move from one sensor to another. From the measured time, the software can calculate the speed. Other options include acceleration and momentum

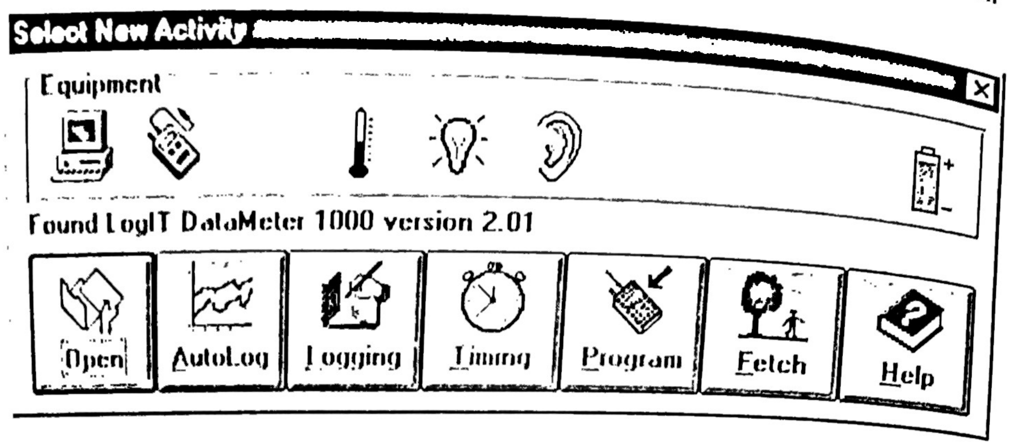
Tutorial - Running the software

The LogIT Lab software can be run in the usual ways:

Windows 3.10 / 3.11 — Double click on the LogIT Lab icon in the Program Manager

Windows 95 / 98 / NT 4 — Select LogIT Lab from the Start Menu's Programs list

Once started, an initial display identifies the LogIT Lab software for a few seconds, then the Select New Activity window is shown (as illustrated below).



The top half of the window shows the equipment currently detected. In this case there is a computer (obviously!), a LogIT DataMeter 1000 data logger, three sensors (temperature, light level and sound level) and the logger's battery is well charged. If the logger is not found, check all connections and the logger's battery or mains supply. If it still does not work, select Help and look up 'troubleshooting'.

The lower half of the window has seven buttons to enable selection of the main activities. Those shown with grey text are not available with the equipment currently detected.

Moving the mouse pointer over any of the icons or buttons will produce a short description, such as the name and range of a sensor.

Tutorial - Your first experiment

So how do you measure things?

The first step is to decide which sensor, or sensors, are needed. Initially just

choose a temperature sensor.

Temperature sensors are a good starting point as they are simple, easy to understand, easy to interact with and give reliable results.

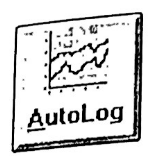
Connect the logger to a spare serial port on your computer using the special LogIT serial lead. Connections on PCs are often not well labelled and there are two sizes of connector in use. The LogIT serial lead has a 9 pin connector. If you only have a 25 pin serial connector available you will need a 25 to 9 pin adapter (often called a mouse adapter).

Ensure your logger has a power source (battery or mains adapter).

Plug the sensor into one of the sensor sockets. While not essential its good practice to use socket 1 for the first sensor, 2 for the second and 3 for the third sensor.

If the software is not currently showing the Select New Activity window, choose New from the File menu.

If all is well the window should show icons for the logger and sensor(s). If not, check all connections and the battery. If it still does not work consult the Troubleshooting section of the built-in Help (from the LogIT Lab Help menu).

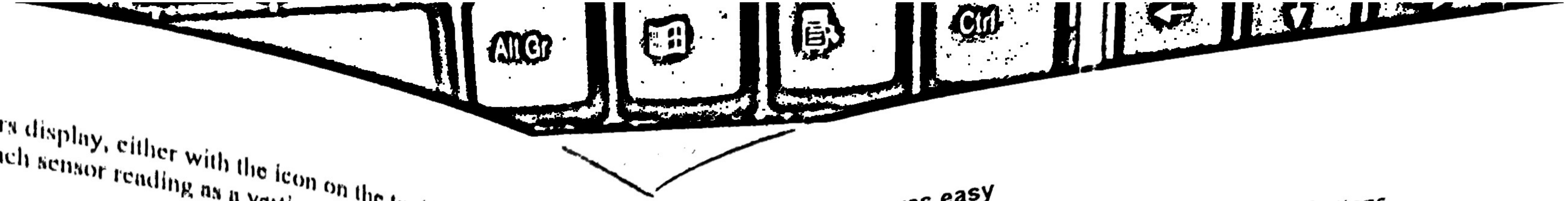


When the logger and sensor icons are visible you can move the mouse pointer to them for a little information about each. When ready click on the AutoLog button.

You should now see a blank graph. The graph's X axis should show elapsed time and the Y axis should show a suitable scale for the first sensor.

The large boxes at the right of the graph show the current value of each sensor and of elapsed time. Currently elapsed time is not shown, but the sensor values should be meaningful. Try holding the end of the temperature sensor and watching the reading change.

At this point you are measuring but not logging the results.

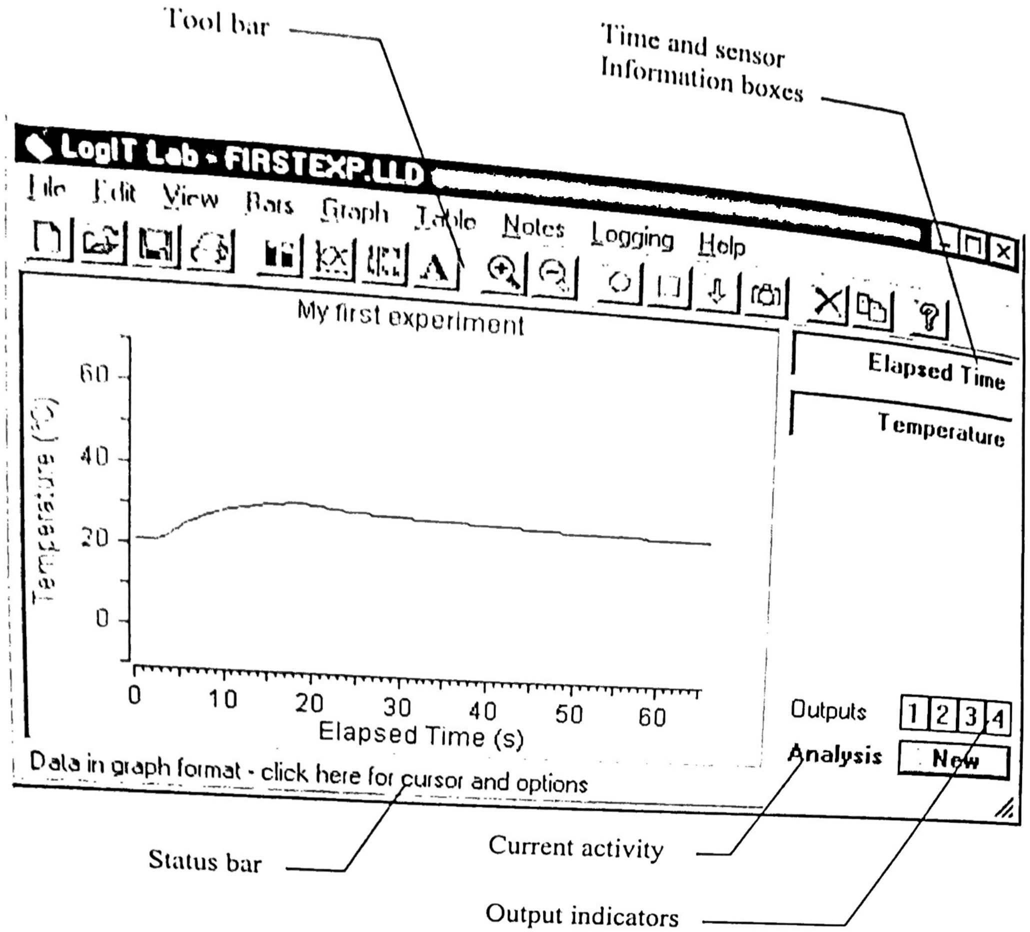


Try selecting the Bars display, either with the icon on the tool bar or from the View menu. This shows each sensor reading as a vertical bar.

Select Start to begin logging measurements, either with the icon, the Start button or from the Logging menu. The graph will now start updating.

Select Stop to finish logging measurements.

The screen should look something like the following illustration.



Tutorial - OK, that was easy

So, you managed to collect some data and fancy pressing more buttons.

Having got the graph of your first experiment it would be worth saving it for future generations to admire.

Select Save, either the icon or from the File menu. If the experiment does not already have a file name you will be presented with a standard Save Window.

If any Window pops up, like the Save Window, which you do not understand, just select its Help button or press key F1.

If you have used a temperature sensor and just tried warming it up in your hands, the graph trace will be rather flat and not too impressive.

Try Auto Zoom to expand the graph's Y axis to better show small changes.

Now you can see the changes more clearly, but just what was the highest value the trace reached?
To find out, move the mouse pointer to the highest point and click the left mouse button. This will display a vertical cursor line and the sensor boxes to the right will show the elapsed time and sensor readings at that point. The cursor will follow the mouse pointer allowing you to take readings from anywhere on the graph. A second click removes the cursor.

So what if you want to see one part of the graph in even more detail?
To select an area to zoom into, drag a box around it with the mouse. Move the pointer to one corner of an imaginary box on the graph. Press and hold down the left mouse button, then move the pointer to the opposite corner. Now release the mouse button and the graph will redraw showing only the area defined.

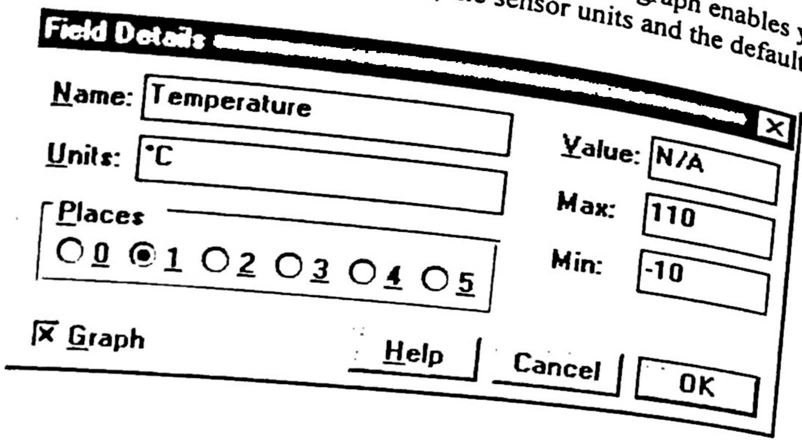
Select Zoom Out to return the graph scales to their default values.

Double clicking (click twice quickly) on the graph toggles the display view between auto zoom and default zoom.

Clicking around the edges of the graph allows you to change the title and graph scales. You can even add a second Y axis scale to the right of the graph.

Further graph options are available from the Graph Menu, including line style and grid.

Clicking on the sensor information boxes to the right of the graph enables you to select the number of decimal places, the sensor name, the sensor units and the default scale limits.



Its worth noting that all of these things can also be done during logging, so you do not have to sit around until the end to examine your data.

What about a table of results?

Selecting Table displays a table of results. From the Edit Menu, Copy Table will copy the table to the Clipboard from where it can be Pasted into a spreadsheet.

The Graph icon returns the display to the graph. The Edit Menu enables the graph to be copied to the Clipboard as a picture to include in reports.

A Notes can also be entered to accompany your experimental data.

For help choosing suitable equipment for a particular task, select Choosing Equipment from the LogIT Lab Help menu. This provides a database of equipment and its capabilities.

Tutorial - Feedback control

LogIT Lab also offers feedback control, enabling your system to respond to changes in measured values. An example of this would be to turn a heater on when the temperature gets too low.

The sophistication of control provided by LogIT Lab does not compete with dedicated control technology, but is adequate to build a functioning and practical feedback control system.

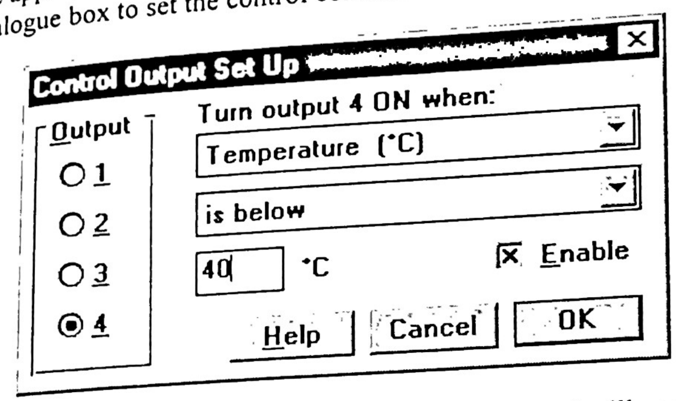
All LogIT data loggers have built in control facilities, but additional hardware is required to utilise them. For extremely simple applications you can use Control devices which plug into sensor sockets. Alternatively you can use SwitchIT for up to four outputs.

So why would you bother?

- For its own sake (to learn about feedback control)
- To eliminate one variable in an environment when trying to study another
- To produce a useful alarm system (eg. Frost alarm)
- To produce a useful process control system (eg. Temperature controller)

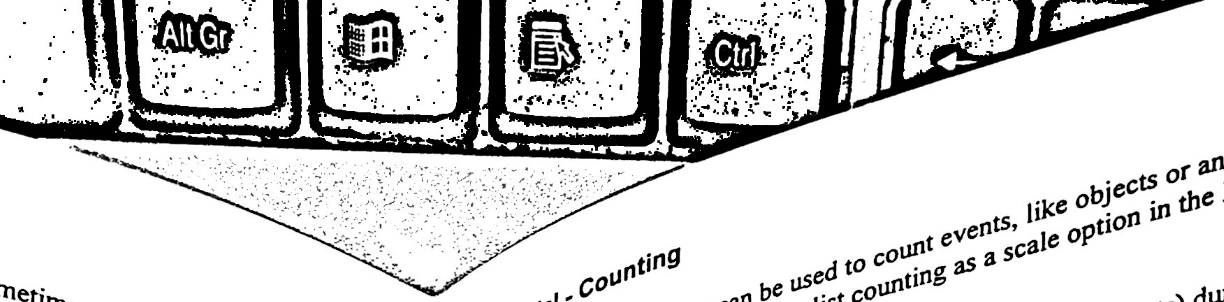
So how do you set up a control system?

Feedback control requires a condition to be specified which, when met, will turn the output on. To do this, first connect the sensor(s) and control device or SwitchIT, then select AutoLog from the Select New Activity window. The graph display will show four small boxes at the bottom right of the screen, representing the four possible outputs. Click the appropriate one of these or select Control from the Logging Menu. Fill in the resulting dialogue box to set the control condition.



Output 4 is either SwitchIT's fourth relay or DataMeter's internal beeper.

The output will now turn on and off as specified, and will continue to do so during subsequent logging.



Tutorial - Remote logging

So far we have only considered logging in real time, sometimes called as it happens or Live logging. This is where the logger is connected to the computer and the computer stores the data.

Remote logging is where the logger is used independently of the computer and stores results in its own internal memory. This data is later *fetched* from the logger for display and analysis on a computer.
LogIT SL and LogIT DataMeter 1000 are capable of remote logging, while LogIT Live is only able to work in real time.

Remote AutoLog is similar to real time - all you need to do is plug in the required sensors and select start. When you have finished collecting data, select stop. LogIT SL and DataMeter both provide this facility with just a few simple buttons. Consult your data logger's instruction manual for full details.

Once the data has been collected, it can be transferred to the computer with the Fetch facility (available from the Select New Activity window).

In addition to AutoLog both LogIT SL and DataMeter can be set up with specific logging rates and other options. DataMeter can be set up from its built in display and buttons, while LogIT SL has to be set up from a computer.

The LogIT SL programming facility is available from the Select New Activity window and uses the same Wizard as used to set up real time logging. Once you have selected the required options LogIT SL is programmed ready for logging.

After each programmed logging session LogIT SL reverts back to AutoLog. This is to ensure that you can rely on LogIT SL to work in a predictable way - not just the way it was last programmed.

Tutorial - Counting

Some switch type sensors can be used to count events, like objects or animals passing through a light beam. Such sensors list counting as a scale option in the Logging set up Wizard.

When selected the software stores the number of counts (eg. objects) during each logging interval. This enables graphs of activity distribution over time, suitable for monitoring animal movement over, say, a 24 hour period.

Tutorial - Printing

The graph can be printed using any graphics printer for which your computer has a suitable printer driver installed (consult your Windows documentation for details).

The File menu has options for Print set up and Printing. The printing option first displays a preview and then, if you are happy with the display, prints a copy.

If you have problems printing, consult the Troubleshooting section of the built-in Help (from the LogIT Lab Help menu).

Tutorial - Using spreadsheets

You may wish to use the data collected with LogIT Lab in a spreadsheet, such as Excel.

You can do this in two ways:

- Save the data as a text file and then open it from the spreadsheet
- Copy and paste the data using the clipboard

The second method is generally quicker and easier. Just display the table, select Copy Table, then from a blank spreadsheet select Paste.

Investigation 1 - Keeping Warm

This topic can be studied by investigating how fast hot tea or coffee (or just water) cools down in cups made of different materials (say polystyrene, metal, china, glass, plastic and paper). It is a simple and reliable experiment requiring only temperature sensors (preferably two or three to allow direct and immediate comparison of several cups).

Warning: To avoid the risk of scolding do not heat the water to more than 55 °C. The experiment will work from this temperature, but the graph looks less dramatic.

Equipment list

- PC with Windows
- LogIT link cable
- LogIT Lab software
- LogIT SL, LIVE or DataMeter - mains power supply optional
- One, two or three temperature sensors (ProTemp sensors require extension leads and clamp stands)
- A range of different types of cup
- A kettle and some water

Warning: Do not spill water on the data logger or computer

Connect the computer, the data logger and the sensors, and load the software. Heat the water in a kettle until it is near boiling (less to completely avoid the risk of scolding).

Warning: Early LogIT SL temperature sensors have a limit of 70 °C (the graph scale will indicate this)

Select AutoLog from the Select New Activity window. Now fill each cup with the same volume of hot water and select Start from the Logging menu.

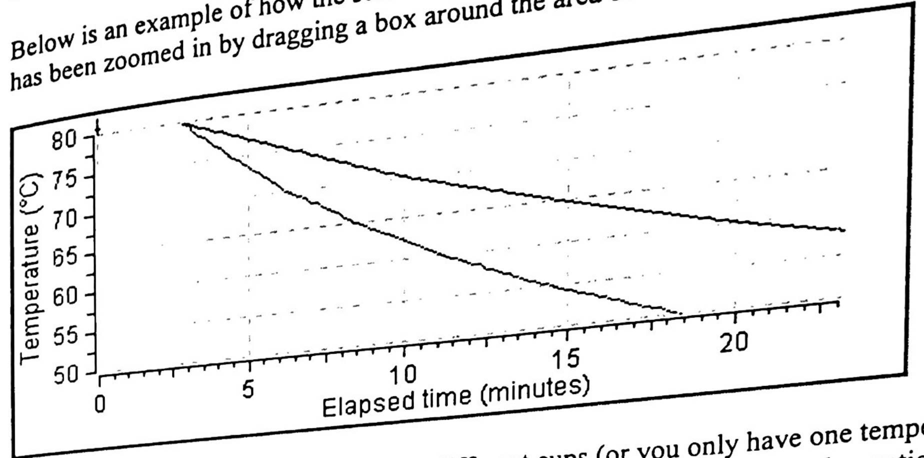
The temperature traces will not all start at exactly the same point as the water was not poured into each cup at the same time, but they should be close enough for comparison.

When the water has cooled significantly, typically after 20 minutes, stop logging by selecting Stop from the Logging menu. To see a full exponential decay, leave the experiment running until the graph trace(s) are nearly flat.

You can now save and print the results.

The most convincing results are obtained if the water starts off very hot (
the water has a relatively small exposed surface area (try using bottles rather than cups) and the cups used have the most varied properties (e.g. metal and polystyrene).

Below is an example of how the screen is likely to look after logging and after the graph has been zoomed in by dragging a box around the area of interest.



If you wish to compare more than three different cups (or you only have one temperature sensor) you will need to repeat the experiment. The Logging menu's Overlay option can be used for this, enabling up to six traces to be compared. Remember to use the same volume of water in each cup and to do each experiment at the same room temperature.

Ideally the temperature sensor should not be touching the side of the cup, so put the sensor in a stand. This is particularly important with the heavy stainless steel ProTemp sensor which might tip over a small cup.

Where discussion might lead

- Why should the cups have lids?
- What would be the result of putting one cup inside the other?
- How can you make the graph traces all start together (i.e. at the same initial temperature)?
- Does the room temperature affect the rate of cooling?
- How do your findings apply to keeping people warm?
- How can you test the insulation properties of such things as buildings, coats and hot wa[illegible]ks?
- D[illegible]ater cool faster if you only half fill the cups?
- [illegible] thin cup [illegible]ter than a short fat one?

Investigation 2 - Swinging a Pendulum

Simple harmonic motion, and the factors affecting the period of oscillation, can be studied with a simple pendulum. The length of the pendulum, the mass of the pendulum and the amplitude of the swing can be varied, while the motion is recorded using a rotary position (or angle) sensor. This is a simple and reliable experiment requiring only the one sensor.

Equipment list

- PC with Windows
- LogIT link cable
- LogIT Lab software
- LogIT SL, LIVE or DataMeter - mains power supply optional
- Rotary position sensor with stiff wire fitted and the end of the wire bent to form a hook
- Sensor extension lead
- Clamp stand
- Set of weights (up to 100g maximum to avoid straining the sensitive rotary sensor)
- Ruler

Connect the computer, the data logger and the sensor, and load the software.

The position sensor should be clamped such that the pendulum hangs at the 180° point. This is achieved by rotating the hexagonal spindle until the mark on the spindle lines up with the mark on the sensor casing. Clamp the sensor so that the marks are at the top.

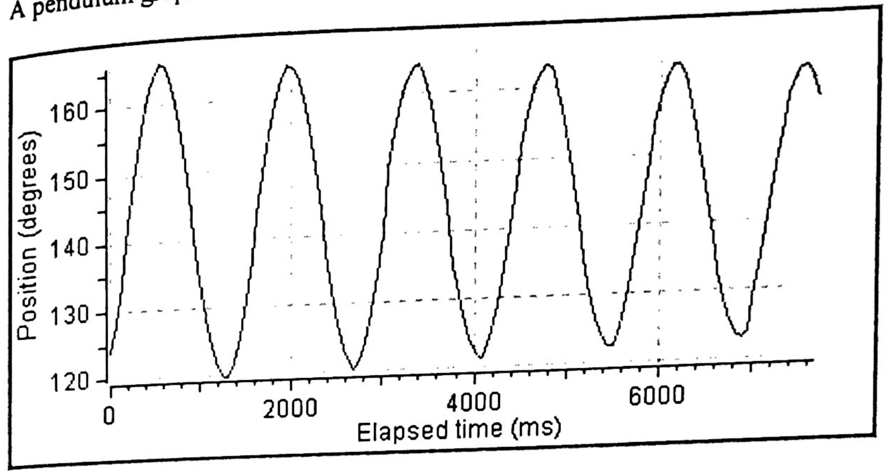
Select Logging from the Select New Activity window and set for Periodic logging, 500 readings, 0.1 second interval (preferably a bit faster, say 0.05 seconds, if your system offers it). Now start the pendulum swinging and select Start from the Logging menu.

Use the AutoZoom (**A**) key to zoom the display so that the graph trace fills the screen (as illustrated)

Measure the period of oscillation with the cursor (click on the graph).

Does the period change as the swing decays?

A pendulum graph will look something like this:



The experiment can now be repeated using different lengths of pendulum, different masses and different amplitude swings (different release heights as measured with the ruler). Which of these affect the period of oscillation?

To repeat the experiment without having to go through the set up procedure each time, select Repeat from the Logging menu.

Where discussion might lead

- What is the best design for a clock pendulum?
- What other ways are there to measure the period of oscillation? *

* One other solution is to use the Timing facility's Simple Harmonic Motion Period measurement option. The pendulum's period can be timed using a light gate to detect movement. A graph of successive periods for each swing can then be displayed.

Investigation 3 - Animal Activity

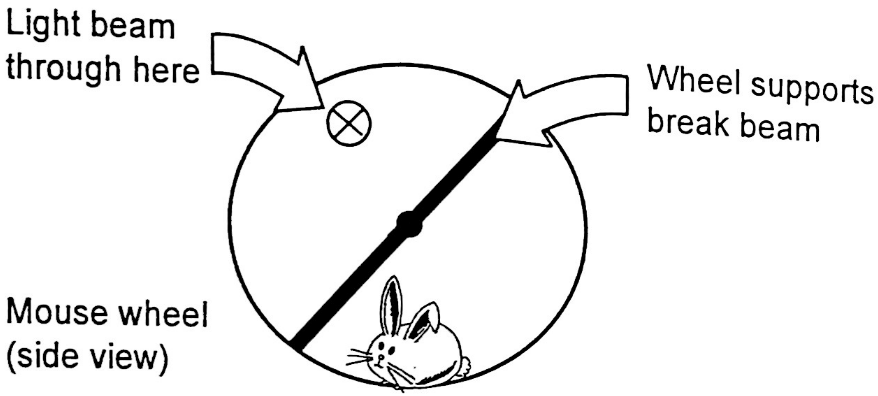
This investigation enables monitoring the activity of a mouse (or other small beast!) over a period of days. The suggested method involves recording the movement of the mouse's wheel and also the light conditions.

Equipment list

- PC with Windows
- LogIT link cable
- LogIT Lab software
- LogIT SL, LIVE or DataMeter (with mains power supply)
- One light gate and something to support it
- One light level sensor
- A mouse and a mouse cage with a wheel

Connect the computer, the data logger and the sensors, and load the software.

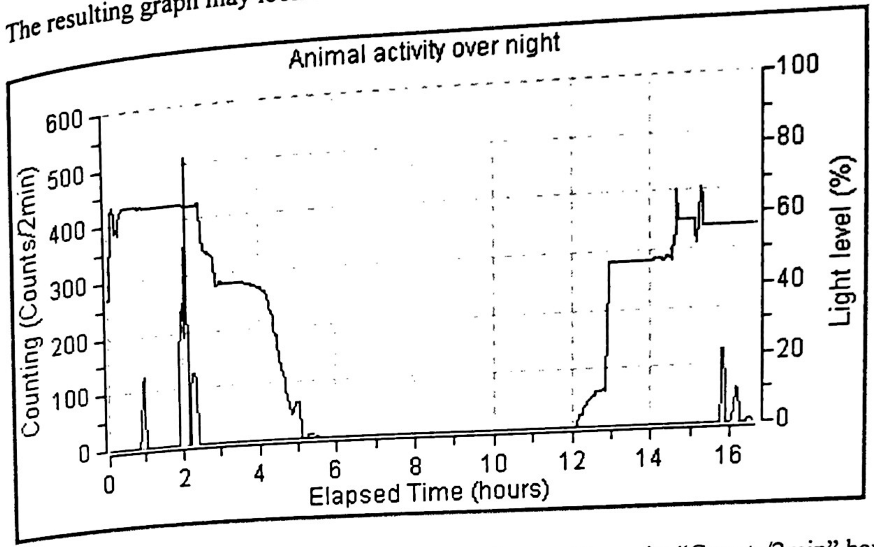
The light gate should be positioned so that its beam passes through the wheel and is broken by the wheel supports as it turns (as illustrated below).



Select Logging from the Select New Activity window and set for Periodic logging, 500 readings, 10 minute intervals and Counts per interval as the sensor scale. Now select Start from the Logging menu.

Leave the experiment running for a day or two, preferably over a weekend so the mouse is not disturbed. Logging will automatically stop at the end of the period selected or when you select Stop from the Logging menu.

The resulting graph may look something like this:



In the above graph, the logging interval is 2 minutes. The units "Counts/2min" have been entered using the Edit Field option in the Edit menu.

Does the mouse use his wheel more when it is light than dark?

Does he get up later at weekends than on week days?

Where discussion might lead

- Are there better ways to monitor the mouse's activity? *
- How might you monitor other animals (such as bees or birds)? **

* One strategy is to use a sound level sensor to listen for activity.
** A bird's feeding habits could be monitored by making a simple mechanical switch to detect a bird on a bird table. This could be connected to LogIT with a digital designer sensor adapter and the software set to count over a suitable period of time.

Investigation 4 - Standing Waves

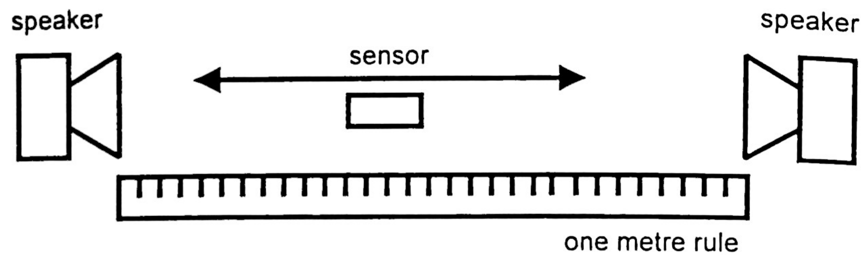
This investigation enables standing waves and interference patterns to be studied. The method involves recording the sound level at regular intervals between two speakers.

Equipment list

- PC with Windows
- LogIT link cable
- LogIT Lab software
- LogIT SL, LIVE or DataMeter - optional mains power supply
- Signal generator and powered/amplified speakers (or speakers and amplifier)
- Sound level sensor with sensor extension lead
- Clamp stand
- Metre rule

Connect the computer, the data logger and the sound sensor, and load the software.

Arrange the speakers and ruler as illustrated below. The sound sensor should be mounted in a clamp stand such that its height is that of the middle of the speaker, and it is directly facing one of the speakers.



Select Logging from the Select New Activity window and set for Snapshot logging. Now select Start from the Logging menu.

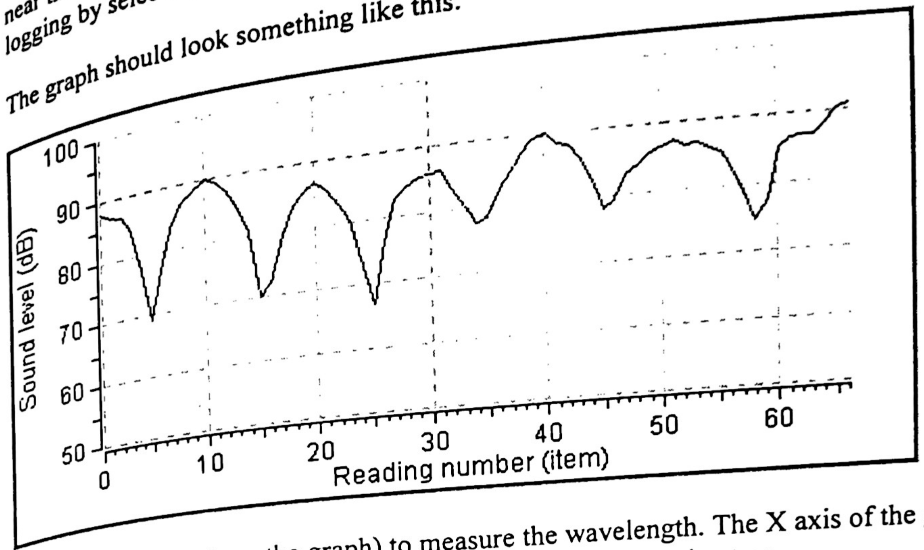
Set the signal generator to produce a sine wave at about 1690Hz. Adjust the volume so that the sound sensor reads around 80dB.

Snapshot logging shows the numeric values from the sensor, continuously updating, but only stores the readings when you select Store from the logging menu (or press the S key).

By moving the sensor to each centimetre mark on the ruler and taking a reading at each location, a graph of the sound level at regular intervals between the speakers can be built

up. Due to the size of the sensor, cable and clamp stand you can not [illegible] near the speakers - but this is not a problem. When you have finished taking readings stop logging by selecting Stop from the Logging menu.

The graph should look something like this:



Use the cursor (click on the graph) to measure the wavelength. The X axis of the graph is the item (or reading number), in this case the distance in centimetres.

Note that the wavelength is the distance between two troughs, not one. This is because the sound level is not directional and so the full wave is shown as two *positive* peaks, not one *positive* and one *negative* peak.

Now try a different frequency (in the range 1 to 2kHz). Is there a relationship between frequency and wavelength?

The experiment can be extended to study interference patterns in two dimensions, by plotting the sound level in locations not directly between the speakers.

Where discussion might lead

- How can you illustrate the interference pattern over an area, not just a straight line?

The example screen shot shown above was actually created using a PC with sound card and speakers, playing a 1692Hz sine wave from the file TONE1692.WAV (included with LogIT Lab software). Only a short sample of the sound has been included so you may wish to extend it using the copy and paste facilities found in most simple wave file editors (often supplied with PCs).

Investigation 5 - Zener Diodes

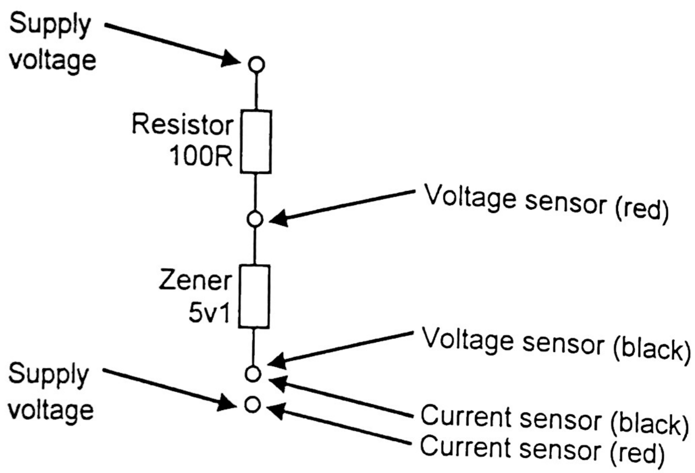
Here we use a voltage sensor and a current sensor to investigate the characteristics of a Zener diode.

Equipment list

- PC with Windows
- LogIT link cable
- LogIT Lab software
- LogIT SL, LIVE or DataMeter - optional mains power supply
- Variable voltage power supply (up to 18V) and suitable connection leads
- Voltage sensor (+/- 25V)
- Current sensor (+/- 1A)
- Zener diode (5.1 volt, 1 watt)
- Resistor (100Ω, 1 watt)

Connect the computer, the data logger and the sensors, and load the software.

Connect the components and sensors as illustrated to the right. The diode can be connected either way round.

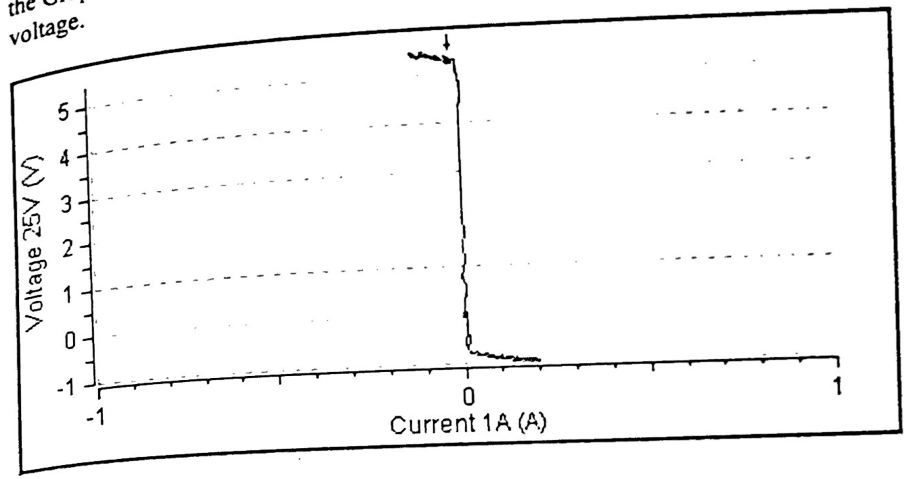


The voltage and current sensors must have their black leads connected together as they actually share a common ground. If you try to make measurements with the black leads in different locations on the circuit you will get incorrect readings. As a result of this relationship the current sensor reads negative when the voltage reads positive, and vice versa. However, an inverted current scale option is provided by the Logging set up wizard.

Select AutoLog from the Select New Activity window and then Start from the Logging menu.

Now adjust the voltage slowly from 0 to about 18 volts and then back to zero. Now reverse the connections to the power supply and again adjust the voltage to 18 volts and back to zero. Then select Stop from the Logging menu.

You can use the values cursor to help interpret the results, however it is far easier to understand if you produce a plot of voltage against current. To do this, select X Axis from the Graph menu . In the example below, the X axis is the current and the Y axis the voltage.



The X/Y plot shows quite clearly the voltage limiting characteristics of a Zener diode. In this case it limits the potential difference across the diode to just over 5 volts one way and just under 1 volt the other. The theoretical values being 5.1 volts and 0.7 volts respectively.

Where discussion might lead

What other electronic components could be studied in this way and what could not?

> The power supply must not have either of the output terminals earthed. This is to prevent the possibility of two earth points in the circuit (one from the logger and one from the power supply), which would cause incorrect readings.

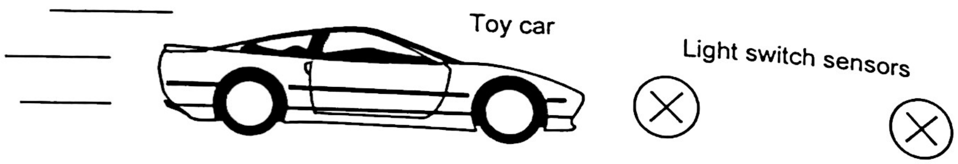
Investigation 6 - Timing a Toy Car

This investigation is an introduction to using LogIT Lab's timing facilities. We use the software to time the movement of a toy car from one sensor to another. No calculations are applied to the result, as they would be if we were measuring, say, speed.

Equipment list

- PC with Windows
- LogIT link cable
- LogIT Lab software
- LogIT SL, LIVE or DataMeter - optional mains power supply
- Two light gate or light switch sensors
- A toy car
- A long ruler or tape measure

Select Timing from the Select New Activity window and then Time, sensor to sensor and auto repeat on. Now select Start from the Logging menu.



Push the car so that is passes the sensors. The timer should start when the car reaches the first sensor and stop when it reaches the second sensor.

To perform a more meaningful experiment, the car should be run down a slope, preferably guided by a track. This enables the car to be released (rather than pushed) from different distances up the slope. The relationship between the distance up the slope and the time taken to travel between the sensors can then be observed, leading to the concept of speed.

If you add a data field (from the Edit menu) and enter the distance up the slope, you can then plot a graph of time between sensors against distance up the slope.

> If you are using light switch sensors you will need a light source, such as a torch or natural light from a window. Note: fluorescent lights flash on and off very rapidly (too fast for the human eye to notice) and can cause false triggering of nearby light switch sensors.

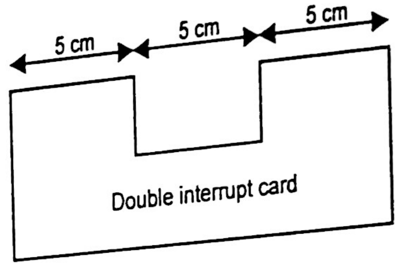
Investigation 7 - Acceleration

Uniform acceleration is determined by measuring the velocity of a object at two points a short distance apart. The acceleration is calculated from the change in velocity and the time taken for that change.

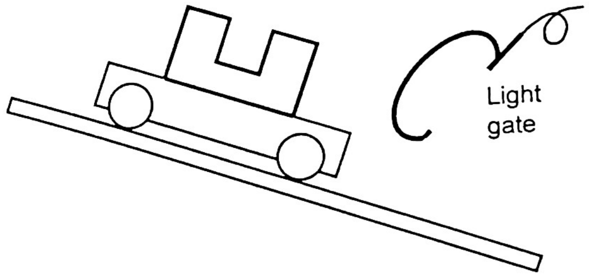
$$\text{uniform acceleration} = \frac{\text{change in velocity}}{\text{time taken for change}}$$

Equipment list

- PC with Windows
- LogIT link cable
- LogIT Lab software
- LogIT SL, LIVE or DataMeter
- One light gate
- Trolley and runway
  or air track and glider
- Supports for runway or track
- Double interrupt card
- A long ruler or tape measure



The trolley is set up as shown below. The runway slopes such that the trolley rolls some measured distance down to the light gate, where its motion is timed to determine two velocities and the time between them. Acceleration is then calculated automatically.



Select Timing from the Select New Activity window and then acceleration, time at sensor, auto repeat on and length 5 cm. Now select Start from the Logging menu.

How does the slope of the runway affect the acceleration?
What affect does the distance from the release point to the light gate have?
Is acceleration affected by giving the trolley a gentle push before it reaches the gate?
How can the experiment be adapted to investigate the affect a measurable force has on the acceleration of the trolley?

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